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RESEARCH IN RELATIONS BETWEEN THE NORTH ATLANTIC SEA ICE AND AR--ETC(U)

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WOODS HOLE OCEANOGRAPHIC INSTITUTION

Woods Hole, Massachusetts

(14) WHOI-REF-

Reference No. 50-23

(6) Research in Relations between the North Atlantic Sea Ice and Arctic Weather,

conducted during the period February 15 to May 15, 1950.

(9) Periodic Status Report, (15)
Submitted to the Office of Naval Research
Under Contract N6onr-277
Task Order No. V

(11) June 1950 (12) 9

APPROVED FOR DISTRIBUTION C.O'D. Iselin
Director

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According to the terms of Contract N6onr-277, Task Order No. V, the work to be performed by the Contractor shall consist of the following:

1. Select monthly and seasonal ice data beginning approximately with this century, prepared by the Danish Meteorological Institute and the International Ice Patrol, and which were treated for individual regions in a recent investigation by L. Koch (9, Koch, 1945).

2. From the available historical series of the mean monthly northern hemisphere sea-level and regional upper-air pressure charts, and also from the seasonal charts which are to be prepared, compute zonal, meridianal, and other significant indices of the large-scale atmospheric circulation contemporary with and preceding various ice conditions in the several regions investigated.

3. Prepare mean monthly and seasonal series of North Atlantic sea temperatures from data collected by the International Council for the Exploration of the Sea and the Hydrographic Offices of the United States and British Navies.

4. Compute mean monthly and seasonal series of water transports in regions that have possible bearings on the ice conditions.

5. Obtain from the wind velocities to be derived from the mean monthly and seasonal sea-level pressure charts estimates of the water-transport in the trade and other North Atlantic areas for which no direct determinations can be had.

6. Develop methods for estimating the extent and mechanism of ice melting and young-ice formation.

7. Investigate possible relations between the critically evaluated dynamic and thermal circulation indices and contemporary and following ice conditions.

<u>Relation of Ice off Iceland to the Temperature of Iceland, Archangel, Vardo, etc.</u>

The report treating the long series of data on the ice off Iceland in relation to the contemporary, following and preceding temperature of Iceland, northern Europe and northeastern USA has been completed. The following is quoted from the Summary.

"The results of the comparison of the mean decadal ice extreme with the mean temperatures of the corresponding decades at Stykkisholm, Archangel and Vardo indicates on the whole a marked contemporary relationship (Table 1). Thus, the three decades with severe ice off Iceland (1831-40, 1861-70, 1881-90) were accompanied by below average temperatures at Archangel and, in case, of Stykkisholm and Vardo where no data are available for the first decade with severe ice (1831-40), by below average temperatures in the other two decades. Similarly, the three decades with light ice (1841-50, 1921-40) were accompanied by above average temperatures except Vardo in the first decade (see below). Also, the comparison of the mean decadal temperature of northern Europe exclusive of Archangel and Vardo previously treated, and of northeastern USA with the ice off Iceland, indicates that the circulation over these areas is to a certain extent part of the same process that determines the ice off Iceland (Table 2).

"Furthermore, in accordance with the postulated effects of persistence, the temperature at Iceland and Archangel and probably also Vardo* appear related to the preceding ice as well, lower than average temperatures generally

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* From the fact that Vardo lies between Iceland and Archangel and appears more exposed to the influence of the North Atlantic warm water sweeping around North Cape than Archangel, we might have expected better agreement between the Vardo temperatures and the preceding ice than was actually obtained. We have already noted the possibility that the Vardo observations during the early period of that station's operation are approximate only. It is further possible in view of Vardo lying to the west of Archangel that the effect of different ice extremes off Iceland on Vardo's temperature occurs earlier there than at Archangel and for that reason the relation of the Vardo temperature with the ice may not have stood out more clearly in the decadal comparison.

following decades with heavy ice and higher temperatures, decades with light ice, the actual deviation for a given decade depending also on the contemporary ice (Table 1). Again, in addition to the persistence effect that appears to be derived from the ice and cold water locally, in the case of Archangel this effect is apparently strengthened by more of the cold, or less of the cold, water carried southeastward from Iceland to mingle with the northeastward flowing North Atlantic warm water.

"As a consequence, the temperature deviation at Archangel following either a severe- or light-ice decade appears usually greater in the decade after rather than in the decade contemporary with the ice-extreme decade while at Stykkisholm where the persistence effect appears to depend on the preceding ice in its own area solely, the temperature deviation is greater during rather than in the decade following the ice-extreme decade (Table 3).

"No consistent relation was indicated between the ice off Iceland and the preceding temperature of Iceland, Archangel, Vardo, etc.

"The reversal in the ice trend from practically no ice at all during 1919 to 1940 to, on the whole, close to normal conditions during 1941-1948, suggests that <u>everything else being the same</u>, the trend for comparatively high temperatures in the general areas of Iceland, Vardo and Archangel (?) which in accordance with the relationship derived above was on the average maintained also during 1941-1949, is not likely to continue in its recent intensity for very long, the change at Archangel to occur later than at Stykkisholm."

<u>Severity of the Iceberg Season off Newfoundland.</u>

The formula given in the Periodic Status Report for the period February 15 to May 15, 1950 and since slightly revised in conformance with the recently received new Bermuda and St. John's temperature data, was employed to compute the departure from the normal in the iceberg severity this season (1950). The obtained value on a scale of 10, is 1.1. Considering that in each of the 10 cases

during the twenty-three test period, 1927-1949 (see preceding report), the sign of the actual departure was always in agreement with that of the computed when the latter exceeded ± 1.0, the probability that the severity of the iceberg season this year will be above the average is very high*.

* According to unofficial reports as of May 1, the severity of the iceberg season has been above the average.

Table 1

Mean Annual Temperature Deviation from Long-Term Average at Stykkisholm, Vardo and Archangel and the Severity of Ice off Iceland, by Decade during 1831-1940

Decade	Ice Severity	Stykkisholm °C Δ	Archangel °C Δ	Vardo °C Δ
1831-40	Severe	-	-.47°	-
-50	Light	.43*	.35	(-.20)
-60	Moderate	-.22	.18	(-.16)
-70	Severe	-.58	-.36	(-.42)
-80	Moderate	-.13	-.71	-.25
-90	Severe	-.53	-.30	-.17
-1900	Moderate	-.12	-.68	-.29
-10	Moderate	-.12	.01	.03
-20	Moderate	-.20	-.11	.00
-30	Light	.65	.65	.53
-40	Light	1.09	1.41	.97

* 1846-50. ( )Approximate value. °1832 lacking.

Mean Annual Temperature Deviation from Long-Term Average in Northern Europe (Bergen, Edinburg, Oslo, Stockholm, Helsinki, Copenhagen, Leningrad, Moscow) and Northeastern USA (New Haven, Conn.) by Decade and the Severity of Ice off Iceland During 1831-1940

Decade	Ice Severity	Bergen °C Δ	Edinb. °C Δ	Oslo °C Δ	Stock. °C Δ	Copen. °C Δ	Hels. °C Δ	Lenin. °C Δ	Moscow °C Δ	Northern Europe °C Δ	Northeastern USA (New Haven, Conn.) °C Δ
1831-40	Severe	-.05	-.27	-.51	-.43	-.53	-.31	-.84	-.35	-.41	-.83
-50	Light	-.02	.01	-.60	-.25	-.39	-.29	-.24	-.20	-.25	-.04
-60	Moderate	-.02	-.02	-.36	.11	-.28	-.25	-.02	-.15*	-.12	-.48
-70	Severe	-.16	-.17	-.38	-.57	-.33	-.64	-.47	-.66	-.42	-.33
-80	Moderate	-.19	-.28	-.29	-.42	-.25	-.42	-.53	-.41	-.35	.35
-90	Severe	-.14	-.26	.00	-.12	-.19	-.02	.07	-.05	-.09	-.41
-00	Moderate	-.15	.23	.19	.23	.18	-.05	-.11	-.13	.05	-.06
1901-10	Moderate	-.01	-.07	.30	.02	.06	.19	.24	.21	.12	-.05
-20	Moderate	.00	.09	.41	.22	.40	.26	.29	.19	.23	.38
-30	Light	.09	.10	.20	.16	.28	.34	.33	.38	.24	.59
-40	Light	.65	.59	1.09	1.03	.93	1.24	1.14	1.17	.98	.86

* Based on 9 years only

Table 3

Differences in Temperature Deviations Between Archangel and Stykkisholm for Decades Following Severe and Light Ice, Respectively, off Iceland: 1831-1949

Decade Contemporary	Decade Following	Ice Character (Contemporary)	Ice Character (Following)	Archangel °C Δ	Stykkisholm °C Δ	Difference °C Δ
1831-40		Severe		-.47	-	
	1841-50		Light	.35	.43	-.08
1861-70		Severe		-.36	-.58	
	1871-80		Moderate	-.58	-.13	-.45
1881-90		Severe		-.30	-.53	
	1891-00		Moderate	-.68	-.12	-.56
1841-50		Light		.35	.43	
	1851-60		Moderate	.18	-.22	.40
1921-30		Light		.65	.65	
	1931-40		Light	1.41	1.09	.32
1931-40		Light		1.41	1.09	
	1941-49		"Moderate"	2.3*	1.10	

* 1949 only